

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Cyclosorus boydiae

Common Name:

Boyd's maiden fern

Lead region:

Region 1 (Pacific Region)

Information current as of:

06/01/2013

Status/Action

☐ Funding provided for a proposed rule. Assessment not updated.

☐ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

☐ New Candidate

☒ Continuing Candidate

☐ Candidate Removal

☐ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status

☐ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species

☐ Range is no longer a U.S. territory

☐ Insufficient information exists on biological vulnerability and threats to support listing

☐ Taxon mistakenly included in past notice of review

☐ Taxon does not meet the definition of "species"

☐ Taxon believed to be extinct

☐ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

X Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing?
Yes

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (<http://endangered.fws.gov/>) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories:** Hawaii
- **US Counties:** Hawaii, HI, Honolulu, HI, Maui, HI
- **Countries:** United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories:** Hawaii
- **US Counties:** Honolulu, HI, Maui, HI
- **Countries:** United States

Land Ownership:

Cyclosorus boydiae is known from five populations on Maui, two on Federal land (Haleakala National Park) and three on private land in the Koolau Forest Reserve extending into the Hanawi Natural Area Reserve; and from two populations on Oahu, one on State land (Ewa Forest Reserve), and one population on private land. Both Oahu populations are in the Kawaihoa Training Area for the U.S. Army in the Koolau Mountains.

Lead Region Contact:

Lead Field Office Contact:

PACIFIC ISLANDS FISH AND WILDL OFC, Kristi Young, 503 231-6845, kristi_young@fws.gov

Biological Information

Species Description:

Cyclosorus boydiae is a small to medium-sized fern with reclining or erect stems and a large, tangled mass of roots that form a holdfast. Fronds are stiffly upright, once-divided, usually 4 to 12 inches (in) (10 to 30 centimeters (cm)) long. Pinnae are lanceolate, 0.8 to 1.4 in (2 to 3.5 cm) long with obtuse tips (Palmer 2003, pp. 87-88).

Taxonomy:

Cyclosorus boydiae was originally described by Eaton (1879, pp. 361-362). Iwatsuki later moved the species to the genus *Thelypteris* (Iwatsuki 1964, entire; Palmer 2003, pp. 87-88). In 1999, Warren H. Wagner moved the species to *Cyclosorus* and recognized two varieties: var. *kipahuluensis* and var. *boydiae* (Wagner et al. 1999a, entire). In his 2003 review of all Hawaiian ferns, Palmer returned the species to *Christella* and did not recognize any varieties (2003, pp. 87-88). Following Smith et al. 2006, *Christella* was merged into *Cyclosorus* (Snow et al. 2011, entire). This is the most recently accepted name for this taxon.

Habitat/Life History:

Typical habitat for this species is exposed, rocky, moss-covered banks of stream courses in dense wet *Metrosideros-Acacia* (ohia-koa) forest, with other ferns, grasses, and dwarfed woody species (Medeiros et al. 1993, p. 87).

Historical Range/Distribution:

Historically, this species was found on the islands of Oahu, Maui, and Hawaii (Palmer 2003, pp. 87-88). It was known to occur in the Punaluu region of the Koolau Mountains on Oahu and in the Kipahulu and Waihoi valleys on Maui (Medeiros et al. 1993, pp. 86-87). On the island of Hawaii it was known from bare rocks on the bed of the Wailuku River near Hilo (Hillebrand 1888, p. 572; Medeiros et al. 1993, pp. 86-87).

Current Range Distribution:

Currently, *Cyclosorus boydiae* is found only on the islands of Oahu (Koolau Mountains) and Maui (Kipahulu, the Koolau Forest Reserve, and Hanawi Natural Area Reserve (NAR)) (Palmer 2003, pp. 87-88; Hawaii Biodiversity and Mapping Program (HBMP) 2008; Oppenheimer, in litt. 2008; Fay, in litt. 2010; Welton, in litt. 2010).

Population Estimates/Status:

Cyclosorus boydiae is currently known from seven populations totaling approximately 400 individuals. On Maui, there are five populations: one larger population in Kipahulu Valley of approximately 162 individuals; one population at Palikea stream of 64 individuals; and three populations within the northern east Maui drainages of Kopiliula, Wailua Nui, and Wailua Iki in the Koolau Forest Reserve (extending into the Hanawi NAR) of 137 individuals (Wood, in litt. 2007; HBMP 2008; Oppenheimer, in litt. 2008; Welton, in litt. 2010;

Oppenheimer, in litt. 2010). On Oahu, there are two populations, both occurring in the U.S. Army's Kawaihoa Training Area in the Koolau Mountains. One population of about five individuals is found in the Kawaiiki drainage, and the second population of 36 individuals is found along Poamoho stream (Palmer 2003, pp. 87-88; Kam, in litt. 2008; Ching, in litt. 2011).

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Historical populations of *Cyclosorus boydiae* on Oahu have dramatically declined in numbers or disappeared due to man-made stream diversions (Palmer 2003, pp. 87-88).

On Maui, two populations in Haleakala National Park are provided some protection as a result of management of feral pigs; however, the other three Maui populations and the two Oahu populations are not fenced and evidence of pig activity has been reported at all of them (Kawelo, in litt. 2000; Wood, in litt. 2007; HBMP 2008).

Pigs of Asian ancestry were introduced to Hawaii by the Polynesians, and the Eurasian type was introduced to Hawaii by Captain James Cook in 1778, with many other introductions thereafter (Tomich 1986, p. 121). Some pigs raised as food escaped into the forests of Hawaii, Kauai, Oahu, Molokai, Maui, and Niihau, and are now managed as a game animal by the State to optimize hunting opportunities (Tomich 1986, p. 125; State of Hawaii 2001). In a study conducted in the 1980s on feral pig populations in the Kipahulu Valley on Maui, deleterious effects of feral pig rooting on native forest ecosystems was documented (Diong 1982, 408 pp.). Kipahulu Valley consists of a diverse composition of native ecosystems, from near sea level to alpine, and forest types ranging from mesic to wet, dominated by *Acacia koa* (koa) and *Metrosideros polymorpha* (ohia lehua). Rooting by feral pigs was observed to be related to the search for earthworms, with rooting depths averaging 8 inches (20 centimeters) greatly disrupting the leaf litter and topsoil layers and contributing to erosion and changes in ground topography (Diong 1982, pp. 143-150). The feeding habits of pigs were observed to create seed beds, enabling the establishment and spread of weedy species such as *Psidium cattleianum* (strawberry guava) (Diong 1982, pp. 164-165). The study concluded that all aspects of the food habits of pigs are damaging to the structure and function of the Hawaiian forest ecosystem (Diong 1982, pp. 166-167).

Hawaiian ecosystems, having evolved without hoofed mammals, are susceptible to large-scale disturbance by pigs and other introduced ungulates (Loope et al. 1991, p. 3). Because of demonstrated habitat modifications by feral pigs, such as destruction of native plants, disruption of topsoil leading to erosion, and establishment and spread of nonnative plants, the U.S. Fish and Wildlife Service (FWS) believes they are threats to *C. boydiae*.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

None known.

C. Disease or predation:

The two Oahu populations and three Maui populations of *Cyclosorus boydiae* are potentially threatened by predation by feral pigs (Kawelo, in litt. 2005; Wood, in litt. 2007; HBMP 2008). Browsing by ungulates has been observed on many native plant species, including common and rare or endangered species (Cuddihy and Stone 1990, pp. 63-67). Because Hawaii's native plants evolved without any browsing or grazing mammals present, many lost natural defenses to such impacts (Merlin and Juvik 1992, p. 597).

Pigs are omnivorous in their diet. In the study described above on feral pig populations in the Kipahulu Valley, pigs were observed browsing on young shoots, leaves and fronds of a wide variety of plants, over 85 percent of which were endemic species (Diong 1982, p. 138). A stomach content analysis showed that the pigs food sources consisted of native plants, primarily tree ferns (*Cibotium* spp.) at 60 percent and alternating with *Psidium cattleianum* when it was available. Pigs were observed felling and removing the bark of *Clermontia*, *Cibotium*, *Coprosma*, *Psychotria*, and *Hedyotis* species (herbaceous and woody plants) and causing enough damage to kill larger trees over a few months of repeated feedings (Diong 1982, pp. 138, 144).

As of May 2013, we do not have information to indicate that disease poses a threat to *C. boydiae*.

D. The inadequacy of existing regulatory mechanisms:

Cyclosorus boydiae is not currently protected under Hawaii's endangered species law (HRS, Sect. 195-D) or the Federal Endangered Species Act (16 U.S.C. §1531-1544).

Pigs are managed in Hawaii as game animals, but many populate inaccessible areas where hunting is difficult, if not impossible, and therefore has little effect on their numbers (Hawaii Heritage Program 1990, p. 3). Pig hunting is allowed year-round, or during certain months, depending on the area (Hawaii Department of Land and Natural Resources 1999, 2003); however, public hunting does not adequately control the number of ungulates to eliminate this threat to native plant species, including *C. boydiae*.

E. Other natural or manmade factors affecting its continued existence:

Cyclosorus boydiae is threatened by nonnative plant species that degrade and destroy habitat and outcompete native plants (HBMP 2008; Medeiros et al. 1993, pp. 88-89; Palmer 2003, p. 88). The nonnative plants that are the greatest threat to *C. boydiae* are: *Ageratina adenophora* (Maui pamakani), *Holcus lanatus* (common velvet grass), *Hypochoeris radicata* (hairy cats ear), and *Prunella vulgaris* (selfheal) at the Kipahulu Valley populations (Medeiros et al. 1993, p. 88; HBMP 2008); *Ageratina adenophora*, *Clidemia hirta* (Kosters curse), *Hedychium gardnerianum* (kahili ginger), *Paspalum urvillei* (vasey grass), *Prunella vulgaris*, *Rubus rosifolius* (thimbleberry), and *Tibouchina herbacea* (glorybush) at the east Kopiliula population (Wood, in litt. 2007); and *Clidemia hirta* and *Psidium cattleianum* at the Kawaiiki population (HBMP 2008).

Ageratina adenophora is native to tropical America and has naturalized in dry to wet forest on the islands of Oahu, Molokai, Lanai, and Maui (Wagner et al. 1999, pp. 254-255). *Ageratina adenophora* is a shrub 3 to 5 ft (1 to 1.5 m) tall with trailing branches that root on contact with soil. It forms dense mats which prevent regeneration of native plants (Anderson et al. 1992, p. 315; California Invasive Plant Council 2013). It is considered a serious weed in agriculture, especially in rangeland, because it often replaces more desirable vegetation or native species and is fatally toxic to horses and most livestock. The eupatorium gall fly, *Procecidochares utilis*, was introduced to Hawaii in 1944 for control of *A. adenophora* and has been successful in suppressing most of the infestations (Bess and Haramoto 1959, p. 248).

Clidemia hirta is a noxious shrub first cultivated on Oahu. This pest plant forms a dense understory, shading out native plants and hindering their regeneration, and is considered a serious threat (Wagner et al. 1985, p. 41; Smith 1989, p. 189). The most promising biological control to date for *C. hirta* is the *Colletrichum* fungus, *Gloesporioides* f. sp. *clidemiae*, released in 1986. Although there is no quantitative data available, it has an observable negative impact. Other agents tested were a moth (*Antiblemma acclinalis*), a leaf-feeding beetle (*Lius poseidon*), a fruit- and flower-feeding insect (*Mompha trithalama*), and a terminal growth-feeding insect (*Liothrips urichi*), all with lesser control success than the fungus (Smith 1989, p. 189).

Hedychium gardnerianum is native to India (Nagata 1999, p. 1,623). This showy ginger was introduced for ornamental purposes, and was first collected in 1954 at Hawaii Volcanoes National Park (Wester 1992, p. 124). *H. gardnerianum* grows over 3.3 ft (1 m) tall in open light environments, preferring a warm moist

climate; however, it will readily grow in full shade beneath a forest canopy (Smith 1985, pp. 191-192). It forms vast, dense colonies, displacing other plant species, and reproduces by rhizomes where already established. The conspicuous, fleshy, red seeds are dispersed by fruit-eating birds as well as humans. Aircraft-based analysis has found that ginger reduces the amount of nitrogen in the *Metrosideros* forest canopy in Hawaii, a finding subsequently corroborated by ground-based sampling (Asner and Vitousek 2005, entire). It may also block stream edges, altering water flow (Global Invasive Species Database 2006a). *H. gardnerianum* can be controlled by herbicides, but biological control is considered the only practical approach for the long-term management of large infestations in native forests. The ability of the bacterium *Ralstonia* (= *Pseudomonas*) *solanacearum* to cause bacterial wilt in *H. gardnerianum* in the field, together with its lack of virulence in other ginger species, contributes to its potential as a biological control agent (Anderson and Gardner 1999, p. 95; Anderson 2003).

Holcus lanatus is native to Europe and naturalized in Hawaii where it occurs on poor, moist soils (O'Connor 1999, p. 1,551). *H. lanatus* is an aggressive weed, growing rapidly from basal shoots or prolific seed and therefore can become dominant if not controlled. It gradually forces other plants out, reducing species diversity. Allelopathy may also play a role in the dominance of this grass over other grasses (Remison and Snaydon 1980, p. 183). The most effective control measure is physical removal by hand-pulling or hoeing. No effective means of biocontrol have been found (Pitcher and Russo 1988, p. 6).

Hypochoeris radicata is a perennial herb up to 2 ft (3 m) tall, native to Eurasia. In Hawaii, it is naturalized in wet and dry disturbed sites on all the main islands (Wagner et al. 1999b, p. 327). It has a deep, succulent taproot favored by feral pigs, which dig up large areas searching for the roots (Smith 1985, p. 192). Seeds are produced in large numbers and dispersed by wind. It regenerates rapidly from the crown of the taproot after fire (Smith 1985, p. 192).

Paspalum urvillei is a perennial grass native to the New World, now naturalized in subtropical regions. In Hawaii, it is naturalized on all the main islands except Niihau and Kahoolawe, in disturbed mesic areas ranging from 66 to 4,200 ft (20 to 1,280 m) (O'Connor 1999, p. 1,577). *P. urvillei* forms dense stands which displace native vegetation (Motooka et al. 2003). We are unaware of any control methods for this species beyond herbicide application (University of Hawaii 2013).

Prunella vulgaris is a perennial herb in the mint family, native to North and Central America, temperate Europe, and Asia. In Hawaii, *P. vulgaris* is naturalized in mesic or wet forest on Molokai, Maui, and Hawaii (Wagner et al. 1999b, pp. 828-829). It is a low-growing plant that spreads easily with its creeping root stocks and by seed (The Green Web 2006). This herb is used medicinally in China, and extracts have demonstrated anti-viral properties (Sahelian 2006). We are unaware of any control methods for this species.

Psidium cattleianum is a tree native to tropical America that has become widely naturalized on all the main islands of Hawaii (Wagner et al. 1999, p. 971). Found in mesic to wet forests, *P. cattleianum* develops into dense stands in which few other plants can grow, displacing native vegetation. The fruit is eaten by pigs and birds, which then disperse the seeds throughout the forest (Smith 1985, p. 200; Wagner et al. 1999, p. 971). A biological control agent, *Tectococcus ovatus*, has undergone 15 years of testing, and there is a proposal to release this scale insect at Olaa Forest Reserve on the island of Hawaii (ScienceDaily 2008, entire).

Rubus rosifolius is native to Asia and is common in Hawaii in disturbed mesic to wet forest on all of the main islands. It is a sparse shrub, covered with prickles, and has edible red fruit. It invades the understory, forming dense thickets and outcompetes native plant species. It easily reproduces from roots left in the ground, and seeds are spread by feral animals and birds. There is no specific management information for *R. rosifolius*, but techniques used for the control of blackberry (*R. fruticosus*), which is a related species, may be applicable (PIER 2006; Global Invasive Species Database 2006b).

Tibouchina herbacea, a member of the Melastomataceae family, is native to southern Brazil, Uruguay, and Paraguay. In Hawaii, it is naturalized and abundant in disturbed mesic to wet forest on the islands of Hawaii,

Maui, and Lanai (Wagner et al. 1999a, p. 915). It forms dense thickets, crowding out all other plant species and inhibiting regeneration of native plants (University of Hawaii 2013). All members of this genus are legally declared noxious in the state of Hawaii (HAR Title 4, Subtitle 6, Chapter 68). Research is ongoing for biological controls of this species (Smith 1998; The Nature Conservancy 2003, pp. 8-9).

The original native flora of Hawaii consisted of about 1,400 species, nearly 90 percent of which were endemic. Of the current total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent are introduced species and nearly 100 of those are considered pests (Smith 1985, p. 180; Wagner et al. 1999b, p. 45). Confirmed personal observations (HBMP 2008) and several studies (Cuddihy and Stone 1990, p. 74; Wood and Perlman 1997, p. 6-7; Robichaux et al. 1998, p. 4) indicate nonnative plant species may out-compete native plants similar to *C. boydiae*. Competition may be for space, light, water, or nutrients or they may produce a chemical that inhibits the growth of other plants (Smith 1985, pp. 227-230; Cuddihy and Stone 1990, p. 74). In addition, nonnative pest plants found in habitat similar to that of this species have been shown to make the habitat less suitable for native species (Smith 1985, pp. 240-241; Loope and Medeiros 1992, pp. 7-8; Medeiros et al. 1992, pp. 23-24; Ellshoff et al. 1995, pp. ii, 3-4; Meyer and Florence 1996, p. 778; Medeiros et al. 1997, pp. 23-24; Loope et al. 2004, p. 1,472). In particular, alien pest plant species degrade habitat by modifying availability of light, altering soil-water regimes, modifying nutrient cycling, or altering fire characteristics of native plant communities (Smith 1985, pp. 227-230; Cuddihy and Stone 1990, p. 74; Vitousek et al. 1997, pp. 6-10). Because of demonstrated habitat modification and resource competition by nonnative plant species in habitat similar to that of *C. boydiae*, the FWS believes nonnative plant species are a threat to this species.

Conservation Measures Planned or Implemented :

Pig exclosures may provide protection for two Maui populations of this species in Kipahulu Valley in Haleakala National Park. Nonnative plants are being controlled within these exclosures as part of the Parks ongoing habitat management (Medeiros et al. 1993, p. 89).

As of April 2013, the Lyon Arboretum Micropropagation Laboratory maintains approximately 23 plants growing in tissue culture sourced from the Oahu Poamoho Stream population (Imoto, in litt. 2013).

Summary of Threats :

Based on our evaluation of habitat degradation and loss by feral pigs and by competition with nonnative plants, we conclude there is sufficient information to develop a proposed listing rule for this species due to the present and threatened destruction, modification, or curtailment of its habitat and range, and the displacement of individuals of *Cyclosorus boydiae* due to competition with nonnative plants for space, nutrients, water, air, and light, and to historical stream diversions. Predation by feral pigs is a potential threat to *C. boydiae*. We find that this species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

- Protect all individuals from feral pigs by removing pigs from areas where *C. boydiae* populations exist and preventing reinvasion through the use of exclosures.
- Control nonnative plants through physical, mechanical, and biological control methods, as well as herbicides when necessary. Continue to conduct research into potential biocontrol species.

- Conduct field surveys for additional populations in suitable *C. boydiae* habitat.
- Reintroduce individuals into suitable habitat within historic range that is being managed for known threats to this species.
- Propagate and maintain genetic stock

Priority Table

| Magnitude | Immediacy | Taxonomy | Priority |
|-----------------|--------------|-----------------------|----------|
| High | Imminent | Monotypic genus | 1 |
| | | Species | 2 |
| | | Subspecies/Population | 3 |
| | Non-imminent | Monotypic genus | 4 |
| | | Species | 5 |
| | | Subspecies/Population | 6 |
| Moderate to Low | Imminent | Monotypic genus | 7 |
| | | Species | 8 |
| | | Subspecies/Population | 9 |
| | Non-Imminent | Monotype genus | 10 |
| | | Species | 11 |
| | | Subspecies/Population | 12 |

Rationale for Change in Listing Priority Number:

Magnitude:

This species is threatened by feral pigs that degrade and destroy habitat, and by nonnative plants that compete for light and nutrients. Threats to the habitat of *Cyclosorus boydiae*, and to individuals of this species, occur throughout its range and are expected to continue or increase without control or eradication. Feral pigs have been fenced out of two of the seven *C. boydiae* populations and nonnative plants are being controlled at those sites. This species is represented in an ex situ collection. These ongoing conservation efforts for this species will benefit two populations on Maui, but the remaining populations are still impacted by these threats. Long-term monitoring and management will be required to maintain threat free areas.

Imminence :

Habitat degradation by feral pigs and competition with nonnative plants are imminent threats because they are ongoing in two of the five known populations. Possible predation by feral ungulates is considered non-imminent.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

Cyclosorus boydiae does not appear to be appropriate for emergency listing at this time because the

immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. Two populations of *C. boydiae* may benefit from ungulate exclosures and weed control conducted by the National Park Service in Haleakala National Park. This species is represented in an ex situ collection. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *C. boydiae* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

Description of Monitoring:

Much of the information in this form is based on the results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December of 1995, and was updated by personal communication with Arthur Medeiros, USGS-BRD, Joel Lau of the Hawaii Natural Heritage Program in 1995, and Daniel Palmer, pteridologist, in 1995. We incorporated additional new information on this species from information in our files and the most recent reference Hawaiis Ferns and Fern Allies by Daniel Palmer (2003). In 2004, the Pacific Island Office contacted the following species experts: Robert Hobdy, retired from the Hawaii Division of Forestry and Wildlife; Joel Lau; Arthur Medeiros; Hank Oppenheimer, resource manager for the Maui Land and Pineapple Company; and Steve Perlman and Ken Wood of the NTBG. No new information was provided by these individuals and they were not able to clarify the current status of this plant. In 2005, we contacted species experts and Kapua Kawelo, U.S. Army Environmental, provided confirmation of the status of *Cyclosorus boydiae* on Oahu. In 2006, new status and range information was provided by Nellie Sugii, Lyon Arboretum. No new information was provided in 2007. New population status information was provided by Hank Oppenheimer, Plant Extinction Prevention Program (PEPP); Ken Wood, NTBG; and, Roy Kam, HBMP database manager, in 2008. In 2009 no new information was received. In 2010, we received new information from Patti Welton, National Park Service. In 2011, we contacted the species experts listed below, and received information from Susan Ching, PEPP-Oahu, Kapua Kawelo, U.S. Army Environmental Division, and Hank Oppenheimer, PEPP-Maui.

List all experts contacted in 2011:

Name Date Affiliation

Agorastos, Nick 02/16/11 Division of Forestry and Wildlife, Hawaii
Bakutis, Ane 02/16/11 Plant Extinction Prevention Program, Molokai
Ball, Donna 02/16/11 U.S. FWS, Partners Program, Hawaii
Bily, Pat 02/16/11 The Nature Conservancy, Maui
Bio, Kealii 02/16/11 Plant Extinction Prevention Program, Hawaii
Caraway, Vickie 02/22/11 Hawaii Division of Forestry and Wildlife, Oahu
Ching, Susan 02/16/11 Plant Extinction Prevention Program, Oahu
Clark, Michelle 02/16/11 U.S. FWS, Partners Program, Kauai
Duvall, Fern 02/16/11 Hawaii Division of Forestry and Wildlife, Maui
Fay, Kerri 02/16/11 The Nature Conservancy, Maui
Garnett, Bill 02/16/11 National Park Service, Kalaupapa, Molokai
Haus, Bill 02/16/11 National Park Service, Haleakala NP, Maui
Higashino, Jennifer 02/16/11 U.S. FWS, Partners Program, Maui
Imada, Clyde 02/16/11 Bishop Museum, Botany Department
Kawelo, Kapua 02/16/11 U.S. Army, Environmental Division
McDowell, Wendy 02/16/11 Plant Extinction Prevention Program, Kauai
Medeiros, Arthur 02/16/11 U.S. Geological Survey
Moses, Wailana 02/16/11 The Nature Conservancy, Molokai
Oppenheimer, Hank 02/16/11 Plant Extinction Prevention Program, Maui Nui
Perlman, Steve 02/16/11 National Tropical Botanical Garden
Perry, Lyman 02/16/11 Division of Forestry and Wildlife, Hawaii

Pratt, Linda 02/16/11 U.S.G.S., Biological Resources Division
Starr, Forest 02/16/11 U.S. Geological Survey
Stevens, Bryon 02/16/11 DLNR Natural Area Reserves, Maui
Ward, Joe 02/22/11 Puu Kukui Watershed Preserve
Welton, Patti 02/16/11 National Park Service, Haleakala NP, Maui
Wysong, Michael 02/09/10 DLNR Natural Area Reserves, Kauai

The Hawaii Biodiversity and Mapping Program identified this species as critically imperiled (HBMP 2006). Based on the International Union for Conservation of Nature and Natural Resources Red List of Threatened Species, this species is recognized as Endangered (facing a very high risk of extinction in the wild) (Bruegmann and Caraway 2003). *Cyclosorus boydiae* is not included in the list of species in Hawaii's 2005 Comprehensive Wildlife Conservation Strategy (Mitchell et al. 2005, 722 pp.).

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Hawaii

Indicate which State(s) did not provide any information or comment:

none

State Coordination:

On February 20, 2013, we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. We received information on March 23, 2013, and incorporated it into this form.

Literature Cited:

Anderson, R.C., and D.E. Gardner. 1999. An evaluation of the wilt-causing bacterium *Ralstonia solanacearum* as a potential biological control agent for the alien kahili ginger (*Hedychium gardnerianum*) in Hawaiian forests. *Biological Control* 15: 89-96.

Anderson, R.C. 2003. Kahili-make: a biological control project against kahili ginger. Presentation for U.S.G.S. Biological Resources Division, Pacific Island Ecosystems Research Center, Honolulu.

Anderson, S.J., C.P. Stone, and P.K. Higashino. 1992. Distribution and spread of alien plants in Kipahulu Valley, Haleakala National Park, above 2,300 ft elevation. In Stone, C.P., C.W. Smith, and J.T. Tunison (eds.), *Alien Plant Invasions in Native Ecosystems of Hawaii: Management and Research*, Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. Pp. 300-338.

Asner, G., and P. Vitousek. 2005. Scientists use aerial imaging to find hidden invaders in Hawaiian rain forest. Stanford Report, Stanford University, March 9, 2005. 2 pp.
<http://news-service.stanford.edu/news/2005/march9/invade-030905.html>, downloaded on February 21, 2007.

Bess, H.A., and F.H. Haramoto. 1959. Biological control of Pamakani, *Eupatorium adenophorum*, in Hawaii by a tephritid gall fly, *Procecidochares utilis*. 2. Population studies of the weed, the fly, and the parasites of the fly. *Ecology* 40: 244-249.

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Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:



06/13/2013

Date

Concur:

A handwritten signature in blue ink, appearing to read "Dom Ales".

10/28/2013

Date

Did not concur:

Date

Director's Remarks: